diffusion preventing effect of the interposed Au/Cu layer, the interfacial reflection on the CoFe layer was still kept good even after annealing.

In place of 1 nm Au/1 nm Cu, also employable is any of 0.5 nm Au/0.5 nm Cu, 0.5 nm Cu/0.5 nm Au, 0.3 nm Au/0.3 nm Cu/0.3 nm Au, 0.3 nm Au/0.3 nm Cu/0.3 nm Au/0.3 nm Cu, 0.5 nm AuCu/0.5 nm Cu, 1 nm AuCu/0.5 nm Cu, 0.5 nm Ag/0.5 nm Cu, 0.5 nm Cu/0.5 nm Ag, 0.3 nm Ag/0.3 nm Cu/0.3 nm Ag, 0.3 nm Ag/0.3 nm Cu/0.3 nm Ag/0.3 nm Cu, 0.3 nm Pt/0.3 nm Cu, 0.5 nm Cu/0.5 nm Pt, 0.5 nm Pt/0.5 nm Cu, 0.5 nm Pt, 0.5 nm Pt/0.5 nm Cu/0.5 nm Pt/0.5 nm Cu, 0.5 to 1.5 nm AuCu, etc. Those gave the same good results as herein.

The reason why NiFeCr was used as the second magnetic layer herein is as follows: Adding Cr to NiFe increases resistivity ρ, without drastic reducing Ms, whereby the shunt current is reduced. In order to prevent the increase in the magnetostriction, λ, in the positive site, which is caused by the Cr addition, it is desirable that the ratio of Ni to Fe is shifted to the Ni-rich site in some degree from the ordinary zero-magnetostriction composition of Ni:Fe = 81:19. One preferred composition is $Ni_{81}Fe_{15}Cr_4$, which satisfactorily controls all Ms, ρ and magnetostriction. Apart from this, also employable are $Ni_{80}Fe_{20}$, NiFeNb, NiFeRh, etc.

Example d:

In this Example d, produced was a spin valve film of

5 nanometer Ta/1 nm Au/1 nm Cu/7 nm IrMn/2.5 nm CoFe/2.5 nm Cu/4 nm CoFe/0.5 nm Cu/0.5 nm Au/0.5 n Cu/5 nanometer Ta, in the same manner as in Example a.

The film produced herein is a so-called bottom type spin valve film in which the pinned magnetic layer is below the nonmagnetic spacer layer. The upper Cu/Au/Cu layer is the MR-improving layer, by which the thermal stability of the film and also the MR ratio in the film are increased. The lower Au/Cu layer is the subbing film for IrMn, while additionally acting as the MR-improving layer for stabilizing the lattice constant of IrMn. The as-deposited film had an MR ratio of 10 %, and after annealed at 250°C for 4 hours, the annealed film had an MR ratio of 9.5 %. The Cu/Au interface formed an alloy of AuCu.

The upper Ta in the film of this Example d is the protective film, and this is not intended to be reflective. In this Example d, the Cu/Au/Cu layer is the MR-improving layer. Therefore, in this, the CoFe/Au interface and the Cu/Au interface (or the AuCu alloy layer) shall be reflective. Thus, the constitution of the film of this Example obviously differs from the prior art constitution of (e) or (d) mentioned above. In addition, in this, the ultra-thin Cu layer is interposed in the CoFe/Au interface, by which long-term diffusion of Au into the nonmagnetic spacer layer of Cu is prevented. Moreover, in this, since the Au layer is disposed via the layer having

a short Fermi wavelength, the interlayer reflection is much augmented.

In place of the MR-improving layer of 1 nm Au/1 nm Cu, also employable is any of 0.5 to 3 nm Au/0.5 to 3 nm Cu, 0.5 to 3 nm Cu/0.5 to 3 nm Au/0.5 nm Cu, 0.5 to 3 nm AuCu/0.5 to 3 nm Cu, 0.5 to 3 nm Cu/0.5 to 3 nm AuCu/0.5 to 3 nm Cu, 0.5 to 3 nm Ag/0.5 to 3 nm Cu, 0.5 to 3 nm Cu/0.5 to 3 nm Ag/0.5 to 3 nm Cu, 0.5 to 3 nm Pt/0.5 to 3 nm Cu, 0.5 to 3 nm Cu/0.5 to 3 nm Pt/0.5 to 3 nm Cu, 0.5 to 3 nm PtCu/0.5 to 3 nm Cu, 0.5 to 3 nm Cu/0.5 to 3 nm PtCu/0.5 to 3 nm Cu, etc. All those layers gave the same good results as herein.

Regarding the materials for the other layers, the same as in Example a may be referred to. The MR-improving layer as laminated above the free layer in this Example d is not needed to act additionally as a seed layer. Therefore, in this, the thickness of this MR-improving layer may be thin to have a thickness of 1 nanometer or so. However, if the layer is too thick, it will unfavorably increase shunt current, as in Example a. Therefore, the thickness of this layer is preferably at most 5 nanometers.

The MR-improving layer below the antiferromagnetic layer is to control the lattice spacing in the antiferromagnetic layer, thereby preventing the interfacial mixing in the interface between the pinned magnetic layer of CoFe and the antiferromagnetic layer (the interfacial mixing